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Machine Learning and its Applications in Stock Market: A Review

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ABSTRACT

Machine learning is the fastest growing areas of computer science. It has the ability to lets the computer to create the program. It is a subset of Artificial Intelligence (AI), and consists of the more advanced techniques and models that enable computers to figure things out from the data and deliver.It is a subset of Artificial Intelligence (AI), and consists of the more advanced techniques and models that enable computers to figure things out from the data and deliver. It is a field of learning and broadly divided into supervised learning, unsupervised learning, and reinforcement learning. There are many fields where the Machine learning algorithms are used. The some of the important Studies Using Artificial Neural Networks to Predict Stock Market Values are focused in this paper. The objective of the paper is to represent the Machine learning objectives, explore the various Machine learning techniques and algorithms with its applications in the various fields.

Keywords: - Machine Learning (ML), Artificial Intelligence (AI), stock market

1. Introduction

Machine learning(ML) is the branch ofcomputer science which helps computerslearn without being explicitlyprogrammed. [1] "A computer program issaid to learn from experience E with someclass of tasks T and performance measureP if its performance at tasks in T, asmeasured by P, improves with experienceE." -Tom M. Mitchell. Machine Learningis development of algorithms andtechniques instead of programming forperforming functions. [2] Machines learnfrom past examples and historical trendsand based on their previous experience amodel can be built which can be used forprediction of new values. A stock market is a platform for trading of a company's stocks and derivatives at an agreed price. Supply and demand of shares drive the stock market. In any country stock market is one of the most emerging sectors. Nowadays, many people are indirectly or directly related to this sector.

2.Types of Machine Learning Techniques

Machine Learning algorithms are mainly divided into fourcategories: Supervised learning, Unsupervised learning,Semi-supervised learning, and Reinforcement learning [3],as shown in Fig. 1. In the following, we briefly discuss eachtype of learning technique with the scope of their applicabilityto solve real-world problems.

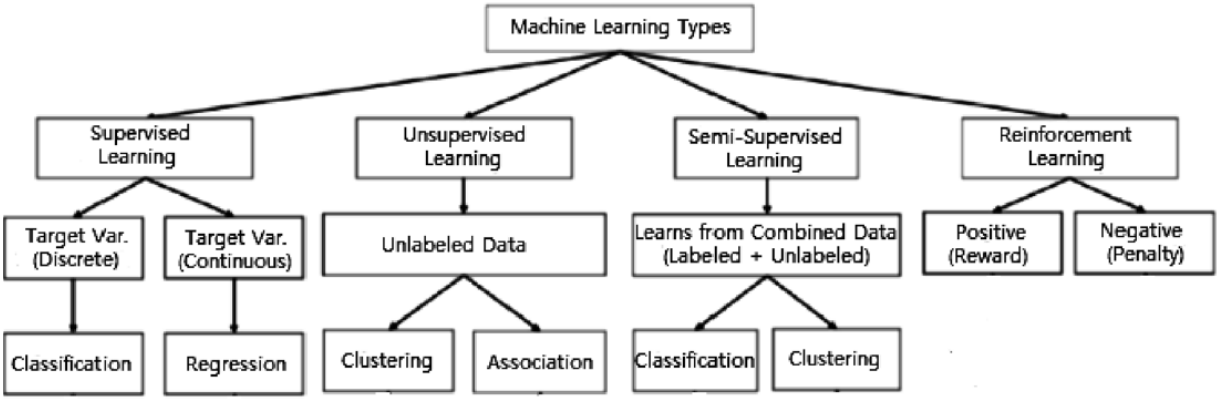

Fig. 1 Various types of machine learning techniques

In Table 1, we summarize various types ofmachine learning techniques with examples. In the following,provide a comprehensive view of machine

learningalgorithms that can be applied to enhance the intelligenceand capabilities of a data-driven application.

3.Machine Learning Algorithms

In this section, we discuss various machine learning algorithmsthat include classification analysis, regressionanalysis, data clustering, association rule learning, featureengineering for dimensionality reduction, as well as deeplearning methods. A general structure of a machine learning basedpredictive model has been shown in Fig. 2, wherethe model is trained from historical data in phase 1 and theoutcome is generated in phase 2 for the new test data.

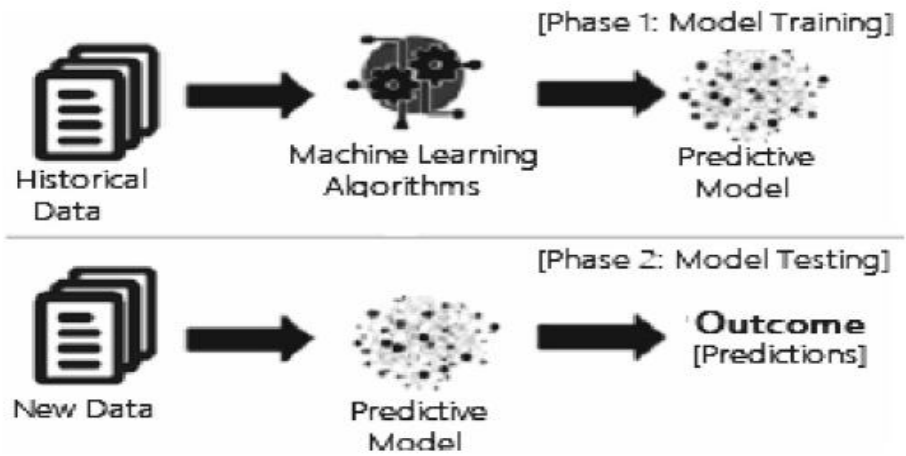

Fig. 2 A general structure of a machine learning based predictivemodel considering both the training and testing phase

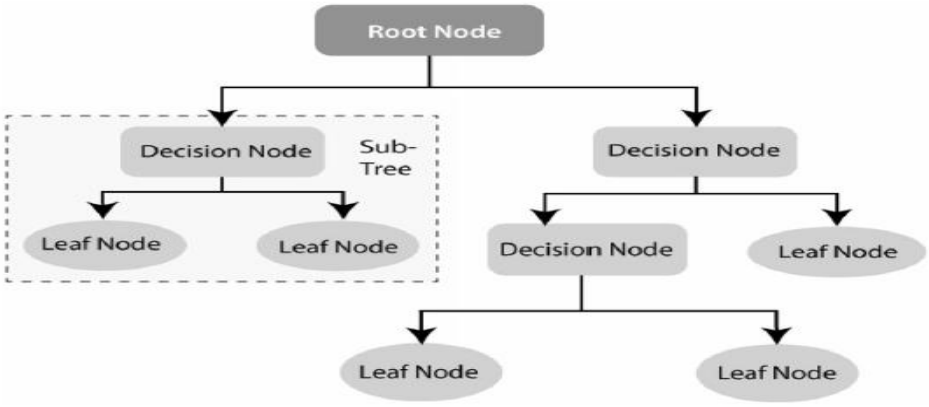

Fig. 3 An example of a decision tree structure

as shown in Fig. 4, on differentdata set sub-samples and uses majority voting or averagesfor the outcome or final result.

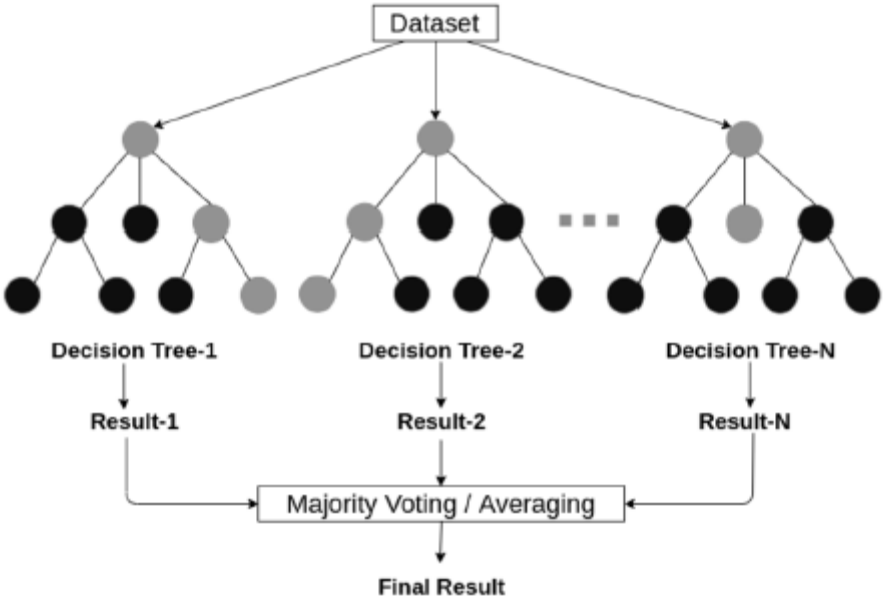

Fig. 4 An example of a random forest structure considering multipledecision trees

4.Applications of Machine Learning

In the current age of the Fourth Industrial Revolution(4IR), machine learning becomes popular in various applicationareas, because of its learning capabilities from thepast and making intelligent decisions. In the following,we summarize and discuss ten popular application areasof machine learning technology.

4.1 Predictive analytics and intelligent decision-making:A major application field of machine learning is intelligentdecision-making by data-driven predictive analytics[2]. The basis of predictive analytics is capturingand exploiting relationships between explanatoryvariables and predicted variables from previous eventsto predict the unknown outcome [4].

4.2 Cybersecurity and threat intelligence: Cybersecurity isone of the most essential areas of Industry 4.0. [4],which is typically the practice of protecting networks,systems, hardware, and data from digital attacks [4].

4.3 Internet of things (IoT) and smart cities: Internet ofThings (IoT) is another essential area of Industry 4.0.[4], which turns everyday objects into smart objectsby allowing them to transmit data and automate taskswithout the need for human interaction. IoT is, therefore,considered to be the big frontier that can enhance almostall activities in our lives, such as smart governance, smart
home, education, communication, transportation, retail,agriculture, health care, business, and many more [7].

4.4 Healthcare and COVID-19 pandemic: Machine learningcan help to solve diagnostic and prognostic problems ina variety of medical domains, such as disease prediction,medical knowledge extraction, detecting regularities indata, patient management, etc. [3, 7, 2]. Coronavirusdisease (COVID-19) is an infectious disease caused bya newly discovered coronavirus, according to the WorldHealth Organization (WHO) [3].

4.5 E-commerce and product recommendations: Product recommendationis one of the most well known and widelyused applications of machine learning, and it is one ofthe most prominent features of almost any e-commercewebsite today. Machine learning technology can assistbusinesses in analyzing their consumers' purchasing historiesand making customized product suggestions fortheir next purchase based on their behavior and preferences.

5. Studies Using Artificial Neural Networks to Predict Stock Market Values

The first set of articles includes studies that primarily focus on stock market prediction using artificial neural networks (ANNs). ANNs are computational models based on biological neural networks. In the network, sets of nodes are grouped into layers starting with an input layer and ending with an output layer.

Signals are transmitted (propagated) through the connected nodes as they learn based on examples and attempt to reduce the level of prediction error. As the system is working to improve its performance, weights are adjusted for the signals between connected nodes.

Jasic and Wood (2004) developed an artificial neural network to predict daily stock market index returns using data from several global stock markets. The focus is on trying to support profitable trading. A method is introduced based on univariate neural networks using untransformed data inputs to provide short-term stock market index return predictions.

The study uses the daily closing values of the Standard and Poor's 500 Index (S&P 500), the German DAX Index, the Japanese TOPIX index, and London's Financial Times Stock Exchange Index (FTSE All Share).The samples for the S&P 500, DAX and FTSE Index are from January 1, 1965 to November 11, 1999.

The sample for TOPIX covers the period from January 1, 1969 to November 11, 1999 since data from earlier years was not available. The prediction performance for the neural network is evaluated against a benchmark linear autoregressive model and prediction improvement is confirmed when applied to the S&P 500 and DAX indices.

Enke and Thawornwong (2005) use a machine learning information gain technique to evaluate the predictive relationships for numerous financial and economic variables. By computing the information gain for each model variable, a ranking of the variables is obtained.

A threshold is determined to select only the strongest relevant variables to be retained in the forecasting models. Neural network models for level estimation and classification are examined for their ability to provide an effective forecast of future values.

A cross-validation technique is also employed to improve the generalizability of several models.The models are compared using S&P data from a 24-year period from March 1976 to December 1999. The results show that the trading strategies guided by the classification models generate higher risk-adjusted profits than the buy-and-hold strategy, the other neural network models, and the linear regression models.

The next study introduces a stochastic time effective neural network model to uncover the predictive relationships of numerous financial and economic variables (Liao and Wang, 2010). It is presumed that investors choose their investment positions by analyzing historical stock market data, and the historical data are given weights based on how near they are to the present.

Developing MLP neural network algorithm to predict future stock price. With Neural Network Toolbox MATLAB, MLP neural network is built and trained for different combinations of data and parameters as shown in below napshots. Fig. 1-3 shows Creation of MLP , Neural Network Model and Output of MLP that is built. For different combinations of input values, the model varies.

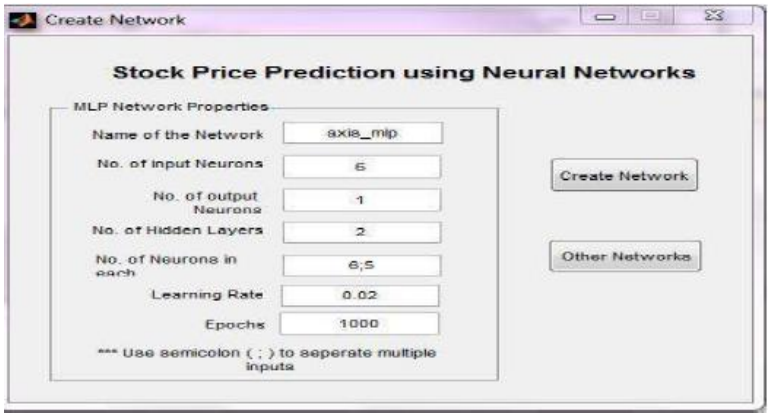

Fig.1.Create MLP

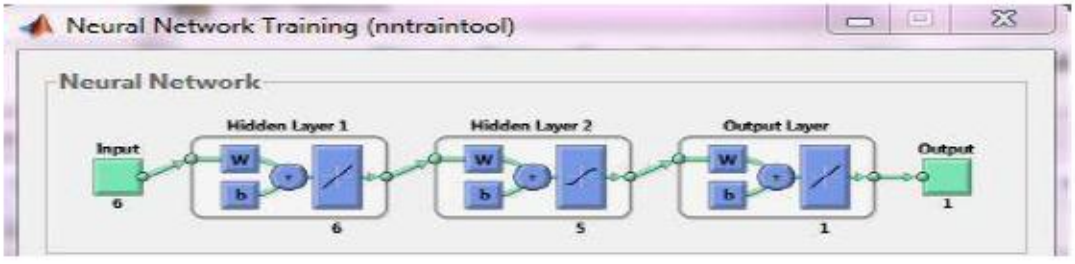

Fig.2.MLP Network

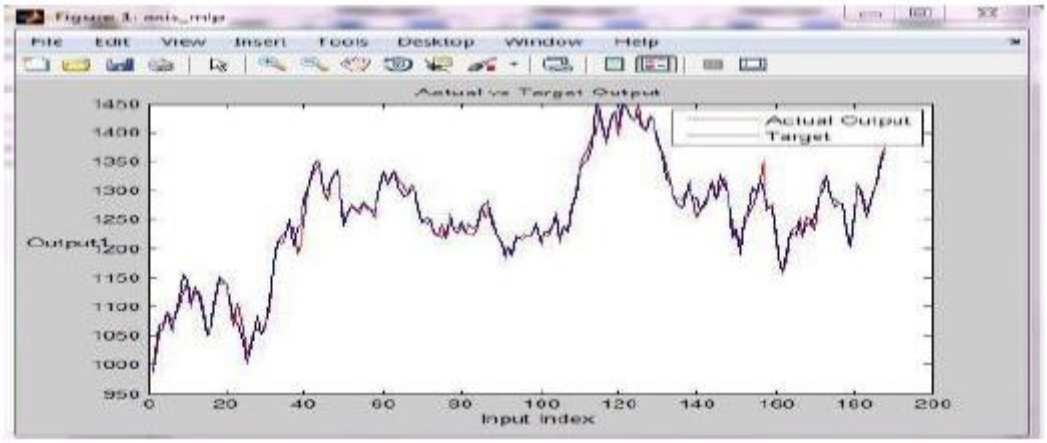

Fig.3.Output of MLP

The nearer the historical data time is to the present, the stronger the impact the data have on the predictive model.The model's effectiveness is analyzed using a numerical experiment based on data from each trading day in an 18-year period from December 19, 1990 to June 7, 2008.

The data is from several stock markets including the Shanghai and Shenzhen Stock Exchange Stock A Index (SAI), Stock B Index (SBI), and the Hang Seng (HIS), Dow Jones Industrial Average (DJIA), NASDAQ Composite (IXIC) and S&P500.

For different combinations of data and parameters, the different results and outputs are taken for all the companies that are listed under NSE. Performance analysis is the most important part. The
numbers here are very deceptive and careful analysis of the same is important.
MSE: Mean Square Error is obtained by squaring the difference of obtained output and the actual output. The main drawback of MSE is that the value of MSE increases with the increase in the stock price. Eg: Assume that a neural network is able to predict the price with 90% accuracy. For stock like Idea cellular whose price is in the range of 150-200 the maximum possible MSE is 400. If the same network is used for Infosys whose price is in the range of 2000 - 3000 the maximum MSE is around 90,000. Hence MSE is a very deceptive number. It is used by the system for training the weights.

MSE various with stock price hence cannot be used for comparison. We need a number which can be compared, for this Normalized MSE is the solution. Normalized MSE is obtained by dividing MSE with the stock price. Correct Direction %: Let us assume that the actual closing
price of the stock is 100 Rs even if the predicted price is 99.9999 Rs it is not accounted in the above percentage.Hence correct direction % should alone not be used for the analysis. It is used along with the normalized MSE for comparing neural networks. Standard Deviation is used for identifying the range for the accuracy.

6.Conclusion

This paper summarized some of machine learning algorithms and its applications. Apart from its application, the paper also briefs about various Machine learning techniques and algorithms with its applications in the various fields. The important Studies Using Artificial Neural Networks to Predict Stock Market Values are focused in this paper .In future author would like to explore advanced ML algorithm and its applications in detail and also discussed several popular application areas based on machine learning techniques to highlight their applicability in various real-world issues. Stock market data are highly time-variant and are normally in a nonlinear pattern, predicting the future price of a stock is highly challenging. Prediction provides knowledgeable information regarding the current status of the stock price movement. In the literature review, different data mining techniques for stock market prediction are reviewed. It is noticed that Artificial Neural Network technique is very useful in predicting stock indices as well as stock price of particular company. Many different algorithms have been used with neural network.

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